

## EDITORIAL COMMENT

Detection of Left Atrial Appendage Thrombus by  
Cardiac Computed Tomography

## A Word of Caution\*

Mario J. Garcia, MD, FACC

New York, New York

In this issue of *JACC*, Martinez et al. (1) report their experience with cardiac computed tomography (CCT) to detect left atrial appendage thrombi in patients with atrial fibrillation undergoing pulmonary vein radiofrequency ablation.

Atrial fibrillation is one of the most common cardiovascular disorders, carrying significant morbidity, including cardio-embolic stroke and heart failure. Slow flow in the left atrial appendage, also called spontaneous echo contrast, as well as left atrial thrombi have been associated with an increased risk of embolic stroke in patients evaluated by transesophageal echocardiography (TEE) (2). Evaluation by TEE is a safe, clinically accepted strategy for the assessment of atrial thrombus before cardioversion in patients with atrial fibrillation who have not received prolonged anticoagulation (3).

[See page 69](#)

Percutaneous pulmonary vein radiofrequency ablation has become a popular alternative to antiarrhythmic therapy for the management of atrial fibrillation. Because the presence of thrombi in the left atrial appendage is considered to increase the risk of cardioembolic stroke in patients undergoing this procedure, some investigators have recommended routine evaluation by TEE. Patients referred for ablation procedures also frequently un-

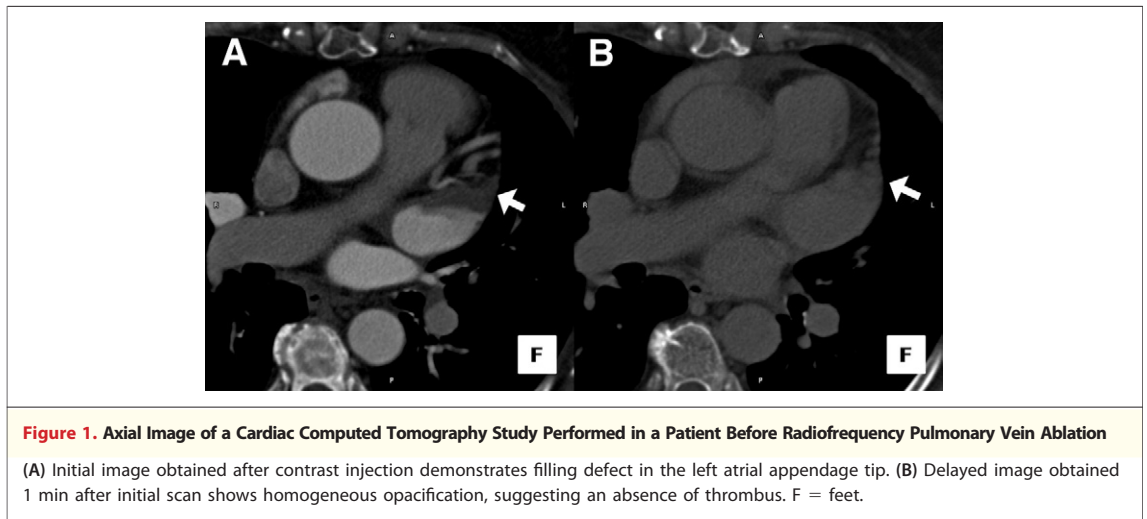
dergo contrast-enhanced CCT for 3-dimensional definition of the atrial and pulmonary vein anatomy and identification of the esophageal location. In most experienced centers, CCT images are integrated with electrophysiological mapping to guide the procedure. Because current high-resolution CCT studies can define the anatomy of the left atrial appendage, the utility of this procedure to exclude thrombi has been recently investigated with the hope of eliminating the need to perform routine evaluation by TEE, a procedure that carries significant discomfort.

In this study, Martinez et al. (1) evaluated 402 consecutive patients undergoing radiofrequency ablation for atrial fibrillation at the Mayo Clinic. All patients had both contrast-enhanced CCT and TEE studies performed within 3 days of each other. There were 362 patients without evidence of thrombi by either method. The CCT identified 40 patients with a filling defect in the appendage, 9 of which were confirmed by TEE as thrombi, whereas the rest were shown to have spontaneous echo contrast. Accordingly, their reported sensitivity and specificity for the detection of thrombi by CCT, with TEE as the reference standard, were 100% and 92%, respectively.

This study represents one of the largest series published to this date, and contrary to most previous publications, it used a nonelectrocardiography (ECG)-gated acquisition protocol. Although not suitable for coronary imaging, nongated CCT provides sufficient spatial resolution for visualization of the left atrium and pulmonary veins but a significantly lower radiation exposure compared with ECG-gated acquisition. Following the principles of ALARA (as low as reasonably achievable), the results of this study should have discouraged the routine use of ECG-gated ac-

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From Cardiovascular Imaging, The Zena and Michael Wiener Cardiovascular Institute, Mount Sinai Hospital, New York, New York. The author has received honoraria as a consultant and/or speaker from Philips Medical Systems, Astra-Zeneca, Abbott, and BG Medicine.



quisition in this setting, because the information provided is equivalent but with a lower potential health risk. However, in a recent series of 170 patients published by Tang et al. (4), with a similar non-ECG-gated CCT, only 4 of 11 thrombi found by TEE were detected by CCT. It is conceivable that motion artifacts of the left atrial appendage in non-ECG-gated studies might prevent the identification of small thrombi.

Although the study by Martinez et al. (1) reports high specificity (362 of 393, 92%), positive predictive value is very low (9 of 40, 23%). Thus, most patients with a positive CCT finding do not have thrombi and should not have their ablation procedure canceled. In these, a confirmatory TEE is required. Poor contrast opacification of the appendage is often caused by slow flow, because image acquisition is performed within seconds of contrast injection. In our practice, we perform routine delayed partial scanning of the appendage 1 to 2 min after the initial scan (Fig. 1). In most false positive cases, contrast opacification of the appendage tip will be demonstrated in the delayed scan.

How should the study of Martinez et al. (1) alter our practice? Clearly, the prevalence of thrombi in the Martinez et al. (1) study as well as in previous studies and in our own experience (5) in this setting has been very low. Most patients included are younger, many have paroxysmal atrial fibrillation without structural heart disease, and most have been anticoagulated before the procedure. Therefore, we cannot conclude with certainty that multidetector computed tomography would be sensitive enough to exclude

thrombi in a higher-risk, higher-prevalence population. Accordingly, we have to interpret these results with caution. Moreover, in the absence of clinical outcome data, CCT should not be used as an alternative to TEE in other settings, such as before electrical cardioversion.

On the basis of the results of this and previously published studies, we feel that younger patients and those with a low congestive heart failure, hypertension, age older than 75 years, and diabetes score could safely undergo radiofrequency ablation without TEE after a negative non-ECG-gated CCT. The use of nongated CCT is particularly desirable in younger patients, because radiation dose is substantially lower than in ECG-gated CT imaging. However, we feel that this study does not provide sufficient data to support the use of CCT to rule out atrial thrombi in patients who are older and/or have a higher congestive heart failure, hypertension, age older than 75 years, and diabetes score. Because of the low positive predictive value found in the Martinez study, incomplete visualization of the appendage or uneven opacification should prompt TEE or intracardiac echocardiographic evaluation of the appendage before left atrial instrumentation, to verify the presence or absence of thrombi. In the meantime, the value of delayed and cine-CT imaging should be evaluated in clinical series, and larger studies should be conducted to assess the diagnostic yield of CCT in higher-risk populations.

**Reprint requests and correspondence:** Dr. Mario J Garcia, Cardiovascular Institute, Mount Sinai Hospital, One Gustave Levy Place, New York, New York 10029. E-mail: [Mario.garcia@mountsinai.org](mailto:Mario.garcia@mountsinai.org).

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